STATE & PRIVATE FORESTRY
FOREST HEALTH PROTECTION
SOUTH SIERRA SHARED SERVICE AREA

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From: State and Private Forestry, Forest Health Protection, South Sierra Shared Service Area

Subject: **Scottiago Project Forest Health and Fuel Reduction Project 2019**

Introduction

The Scottiago Forest Health and Fuels Reduction Project is a collaborative effort with Amador-Calaveras Consensus Group (ACCG) that proposes to improve current forest conditions through several treatment methods within the Sopiago, Middle Fork Consumnes, and Scott Creek watersheds. They are part of 2014 Farm Bill Designated Insect and Disease Watersheds[1] recognized as having high risk for insect and disease-associated mortality[2], and declining forest health observed in recent mortality surveys[3]. These watersheds are considered high priority treatment areas for the Forest. Therefore, main purpose and needs of the project (*Scottiago Scoping letter, Sept 8, 2018*):

- Reduce threat of insect/disease infestations
- Improve forest health
- Reduce potential for catastrophic wildfire

The recent drought event has been categorized as unprecedented and historic for associated widespread tree mortality, minimal amount of precipitation, and warmer temperatures than ever recorded in California (Robeson 2015). Over 129 million trees were estimated killed in the state, 1.6 million in Eldorado County alone from 2010-2016 (Tree Mortality Task Force 2017). New figures show Eldorado National Forest still detected with over half million trees dead in 2018, 99 thousand in Amador County (Tree Mortality Task Force 2018). The resulting bark beetle-associated mortality is considered so severe that some areas experienced >50% of overstory die-off categorizing them in a deforested state.

[1] *Region 5 Designated Insect and Disease Watersheds 2015 part of the 2014 Farm Bill, Section 602(d),* http://www.fs.fed.us/farmbill

[2] *At risk of experiencing substantially increased tree mortality over the next 15 years due to insect or disease infestation, based on the most recent National Insect and Disease Risk Map published by USDA Forest Service.* www.fs.fed.us/foresthealth/technology/nidrm.shtml

[3] *Aerial Detection Mortality Surveys, Forest Health Management, USDA Forest Service 2012-2018.*

ADS and ground assessment

Recent Forest Health Monitoring Aerial Detection Surveys (2015-2018 ADS) of this area found patches of building moderate to severe mortality (>50% of basal area killed). 2015 found insect activity escalating, 2016 and 2017 with the highest levels, finally dropping by 2018. Documentation of the widespread bark beetle outbreak in the Sierra Nevada was conducted by Fettig et al. (2019) who determined that on Eldorado National Forest, 70% ponderosa pines were killed on a per plot basis, not far from 84% determined on the Sequoia and Sierra National Forests. Plots near Omo Ranch Road found about 90% ponderosa pines killed, most >15 inches DBH (Fettig et al 2019). While these plots appeared to have had prior treatment, basal area and brush density were still fairly high. All mortality was attributed to bark beetle infestation.

Detected mortality was initially concentrated in low, dry site ponderosa pines stands. By 2016, 5-40 ponderosa pines were dying per acre within the project boundary (ADS 2016). Later 2016-2017 mortality shifted higher to mixed conifer-white fir – a good indication of mounting drought stress in areas previously receiving sufficient moisture. The largest polygon of 3600 acres was noted in 2017 on the lower half of the project where severe mortality was observed: about 28 ponderosa pines/acre killed, 4 white fir/acre killed (see figure 1, ADS 2017). By 2018, ADS and ground surveys found white firs dying at a higher rate than ponderosa pines.

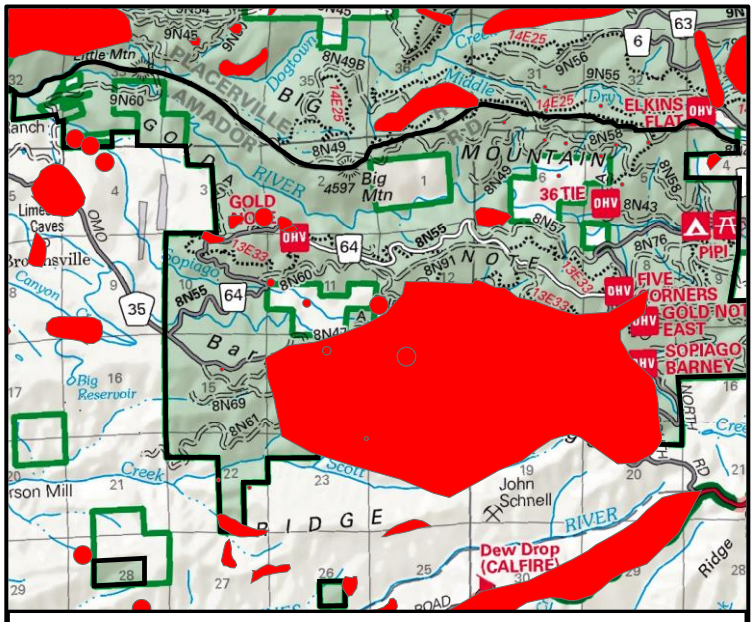

Figure 1. *2017 ADS survey of Scottiago Project (black outline) showing one polygon 3600 acres in size with detected mortality.*

Discussion on Proposed Management Alternatives regarding Forest Health

Native Insects

Western Pine beetle (*Dendroctonus brevicomis*, WPB) targets ponderosa pines but populations can rapidly reach outbreak levels – even localized – if weather and stand conditions are favorable, attacking all host sizes and levels of stress (Miller and Keen 1960). This species is responsible for a large percentage of ponderosa pine mortality occurring in California. Mature ponderosa pines were especially hardest hit during the drought: WPB targeted trees in the upper diameter categories (>20 inches and above), killing up to 90% of ponderosa in some stands (Fettig et al 2019). In untreated stands, the loss of overstory trees shifted size distribution of ponderosa pines to mostly trees below 10 inches (Restanio et al. 2018).

Fir Engraver (*Scolytus ventralis,* FB) is another native bark beetle which concentrates on true firs that are weakened or with prior injury due to other damage or abiotic agents. Compared to WPB, this insect gravitates to host cues rather than intraspecies aggregation pheromones. As hosts become stress due to environmental conditions (ex: drought), their defense mechanisms are reduced and physiological changes occur that incite insect attack. Fir engraver is often considered the main culprit to a tree's demise, but works with a complex of other damage agents – many of which can also cause whole tree mortality. FE activity can also reach outbreak levels, regularly coinciding with two to three years of consecutive drought in California (Ferrell 1986).

Bark beetle prevention

The recent bark beetle epidemic appears to have subsided to some degree due to abundant 2016-2017 winter precipitation. Tree mortality was especially severe in southern Sierra Nevada forests; Eldorado National Forest continues to see mortality still lingering around areas previously infested. The regular occurrence of increased insect activity triggered by drought has been well documented in California (Guarin and Taylor 2005, Oblinger et al. 2011, California Forest Pest Conditions Reports[4]). Therefore, preparation for drier times are best conducted when trees are in better positions to adapt to sudden changes.

Stand density is the one of the primary drivers of bark beetle attraction to stands. Whether determined as basal area or stand density index, densely stocked stands are highly attractive to native pests and most likely to experience higher levels of mortality during drought events than lower density stands (Egan et al. 2009, Fettig 2012, Young et al. 2017). A study comparing past treatment effectiveness during the recent drought concluded that higher tree mortality was found in untreated units, and higher density overall resulted in higher mortality (Restanio et al. 2018). In their study plots on Eldorado, treated plots experienced 5% pine mortality compared to untreated at 35% (Restanio et al 2018). Therefore, despite some units treated 15-20 years ago, current stand conditions in Scottiago Project are still highly susceptible due to stocking levels that are above beetle risk thresholds (Oliver 1995)(see Appendix B). This was observed in a few areas where groups of trees were attacked despite the (lower) BA compared to surrounding forest along (Road 8N54). Thinning prescriptions that reduce overall density are always positive to reducing inter-tree competition, but treatments must be adequate enough to significantly alter the microsite to reduce likelihood of bark beetle infestation (Fettig et al. 2007). Lower density by prescribed fire or mechanical tree removal can reduce physiological stress associated with resource or spatial competition that lead to defense mechanisms weakening and lower resistance of trees (Fettig et al. 2007, Fettig 2012). Particularly for pines, stocking needs to be reduced sufficiently below thresholds of eminent mortality to prevent high losses (Oliver 1995). On more xeric sites, heavier thinning may be appropriate to balance these areas that have lower moisture buffers against drought stress (Young et al. 2017, Fettig 2012). Prescribed burning alone may not sufficiently reduce stocking and may even attract bark beetles in the short-term to residual injured trees (Davis, Hood, and Bentz 2012). Fire will provide long-term benefits that enhance tree resistance but should be integrated with insect and disease prevention (Fettig and Hilszczanski 2015, Hood et al. 2015).

The removal of large trees may be necessary to lower stand density when planning treatments for resiliency against future drought as well as bark beetles. Bennett et al. 2015 conducted a global study of varying forest types experienced drought events, finding that droughts most often led to increases in larger tree mortality whenever bark beetles were contributing factors. Larger trees may be more physiologically challenged for water and resources due to size, therefore more sensitive to drought effects (Bennett et al. 2015). Unfortunately, aggressive bark beetle species like western and mountain pine beetle target larger diameter stems for various reasons, especially if they are weakened or stressed (Miller and Keen 1960, Amman and Cole 1983). In the past twenty years across California, forests lost a majority of trees (mostly ponderosa pines and sugar pines) in 30-50 inch size classes compared to other species and size classes (Cousins et al. 2018). In an assessment of severely affected areas among southern Sierra forests, Fettig et al. 2019 determined ponderosa pines >20+ inch (~50 cm) had mortality rates of around 90%. Across all forests, large ponderosa pines were killed primarily by western pine beetles than any other damage agent (Fettig et al. 2019). Managing for highly diverse forests in sizes, age classes, and species may be better strategies due to uncertainty of future climates and disturbances.

From the recent drought, both Kuskulis (2018) and Fettig et al. (2019) determined *Abies concolor* mortality fairly even across diameter classes, with no significant differences between sizes but dependent on forest type. Drier sites found

[4] *California Forest Pest Conditions Reports 1960-2018, www.caforestpestcouncil.org*

mortality concentrated in the larger diameter classes, while mixed-conifer sites were fairly evenly distributed (Kuskulis 2018). According to North et al. 2009, depending upon the topographic position on the landscape some areas may be able to retain higher densities than others (ex: north faces vs. south). However, white fir has moved down elevational gradients and become pervasive in areas historically dominated by pine in the Sierra Nevada (Safford and Stevens 2017). This gradual change has altered forest succession that north-facing slopes In Yosemite National Park were not regenerating pine in the understory even with overstory mature pine (Guarin and Taylor 2005). Since fir engraver relies on stress signals generated by hosts, planning at the landscape scale of suitable sites or reducing overall stocking of any stand with firs may be more appropriate than protecting individual trees. Assessing proportion of white fir and total stand basal area alone, one can expect sites predominantly white fir will experience more white fir mortality (Ferrell et al. 1994). Realigning density of white fir on drier sites will also improve conditions for pine establishment in many areas. Sufficient thinning appropriate for the site and will reduce potential for high levels of mortality even when drought occurs (Egan et al. 2009). Additional factors such as root disease presence, or dwarf mistletoe infection should be considered into marking guidelines for true firs as well as overall density.

Summary

The Scottiago Project will greatly benefit with recommended treatments to initiate realignment of ecosystems closer to natural range of variation for the sites. Prevention strategies that are integrated with fuel reduction and ecosystem restoration contribute to overall forest health and long-term sustainability. With climate change having the greatest effect on affecting drivers that contribute to tree mortality (van Mantgem et al. 2009), this project is supported to enhance residual forests and ecosystem, maintain vigor and resilience in the face of significantly changing environments or events. As witnessed in recent bark beetle epidemics in Sierra Nevada and southern California, outbreaks are as devastating as catastrophic wildfires in which many public and private resources are affected. Millions of dead trees still on the landscape may contribute to erratic wildfire behavior, and reduction of watershed integrity. The general consensus is that as climate becomes warmer and annual precipitation more variable in California, bark beetle mortality is expected to increase above background levels frequently as host species experience higher levels of stress. Implementing work now during periods of above normal precipitation and

If there are further questions regarding Scottiago Project or concerns regarding this report, please do not hesitate to contact me.

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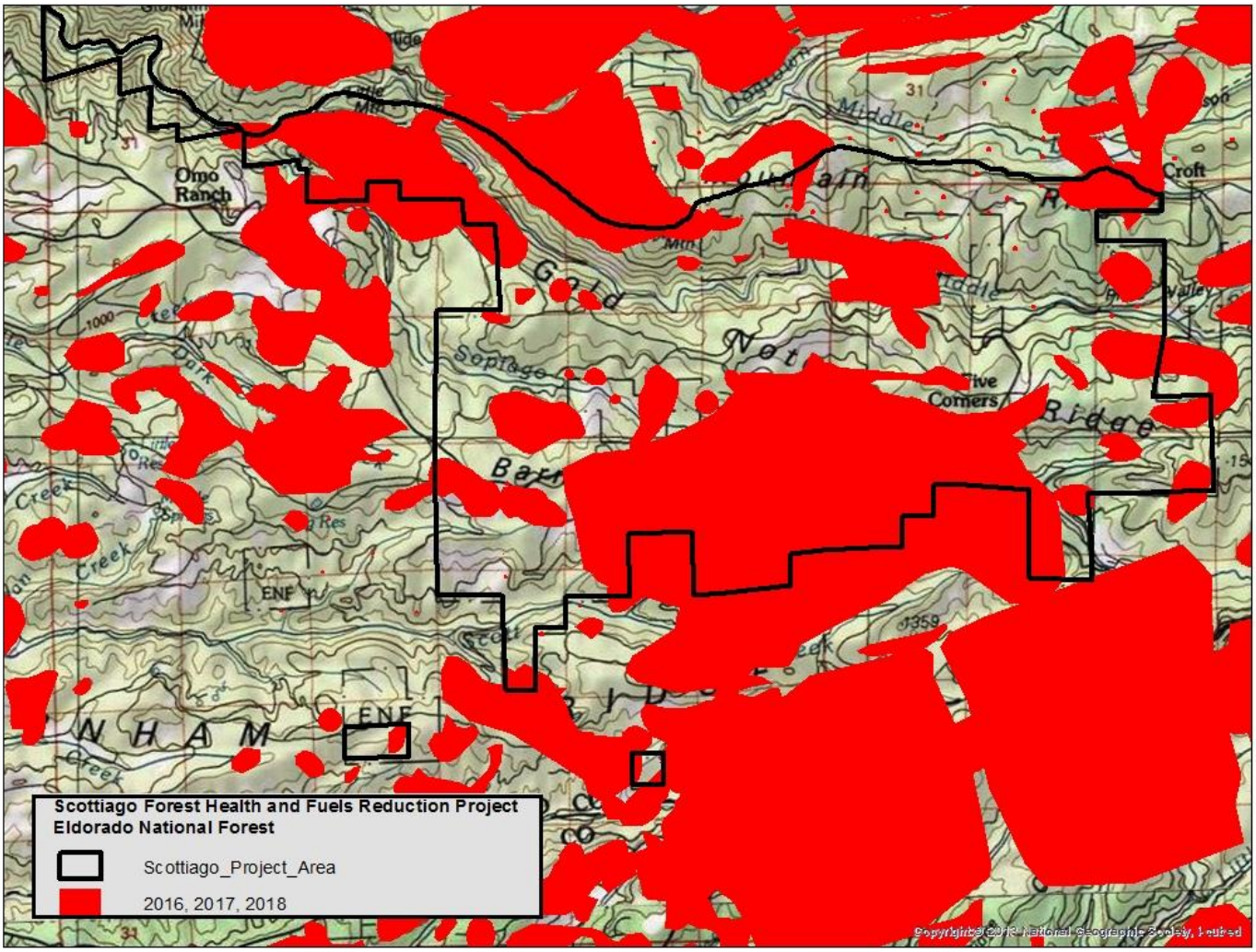
Appendix A. Overlaid 2016-2018 Aerial Detection Mortality Surveys (*red polygons*) within Scottiago Project area to show total area affected with bark beetle mortality; Amador Ranger District, Eldorado National Forest. *Note: most of the largest polygons were detected in 2017 where mortality of ponderosa pines and white firs were occurring in widespread groups across the landscape.*



Appendix B. Bark Beetle Risk Ratings within Scottiago Project. Potential infestation loss from bark beetles based on stand characteristics. *Note: nearly a third of project area is expected to experience up to 25% loss of basal areas in the next 15 years.*